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Competence for the Unforeseen: Social Support and Concurrent Learning as Basic Components of Interaction Under Risk

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This study examines the importance of basic educational, organizational and operational structures of interaction under risk, and how these vary with competence level within an organization. The purpose of this study is to examine whether there are any basic components that can provide further insight into how competence for interaction under risk can be developed and implemented. The first aim was, therefore, to examine the relationship between components of the basic educational, organizational and operational structures and interaction. The second was to assess whether the perceived level of interaction varies due to competence level, controlling for gender, age, and professional experience. The third aim was to determine whether competence level group membership could be predicted by interaction, social support and the specified educational and organizational components. A questionnaire survey was carried out in the autumn of 2017. The respondents were male or female employees of the Norwegian Armed Forces (n = 917). A purposive expert sample of 20 different units with different levels of competence were selected and included commissioned and non-commissioned officers, officer cadets, and conscripts. A total of 1,050 personnel were employed by these units. All the employees were asked to participate. The response rate was 87%. The results showed that social support and concurrent learning were the most important predictors of interaction. Social support and concurrent learning combined with basic capabilities, organizational improvisation, training on decision-making, flexibility, general preparedness, and contingency plans accounted for a considerable proportion of the variance in interaction. Interaction, social support, and the specified educational, organizational, and operational structure components were also significantly associated with competence level and competence group membership. The results showed that it could be possible to prepare for unforeseen events by implementing in particular social and educational measures that improve interaction. This study should be especially relevant to those involved in handling and stabilizing unforeseen events and emergency preparedness management.

Keywords: organizational learning, interaction under risk, social support, concurrent learning, crisis management, the unforeseen, organizational improvisation, flexibility

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INTRODUCTION

This study examines the importance of basic educational, organizational and operational structures of interaction under risk, and how these vary with competency levels within an organization. Previous studies (Kettl, 2003; Comfort, 2007; Bechky and Okhuysen, 2011; Herberg et al., 2018; Torgersen, 2018b) showed that preparedness for the unforeseen was associated with interaction.

Empirical research on interaction under risk, however, is limited and fragmented (Boin and McConnell, 2007; Alpaslan and Mitroff, 2011; Hémond and Robert, 2012; Steigenberger, 2016; Bundy et al., 2017). Even so, it is well-recognized that the competence of the individual, the group and the organization influence how different actors cope in the face of ambiguity and adversity (Argyris and Schön, 1996; Nonaka and Konno, 1998; Hadida et al., 2015; Weick and Sutcliffe, 2015; von Davier et al., 2017). How these skills, attitudes and knowledge can be assumed by employees and built into an organization to achieve better interaction under risk and unforeseen events should be investigated more thoroughly (Boin and van Eeten, 2013; Torgersen, 2018b).

Organizations in a changing and insecure environment are likely to anticipate that they will be faced with and must respond to hazards, crisis, and disasters that they are not prepared for (Garvin et al., 2008; Van Wart and Kapucu, 2011). These can range from everyday crises that affect individuals to major global risks such as natural disasters, cyber-attacks, pandemics and terrorist attacks (Haddow et al., 2017). They manifest as disorder and interruptions of routine (Lu and Xue, 2016), are more transboundary in nature (Ansell et al., 2010) and are "wicked problems" (Head and Alford, 2015). They occur suddenly and unpredictably, the risk level often being high (Torgersen, 2018b). Preparing for such events may be particularly important to organizations such as the police, the military and the fire and rescue service. Emergency preparedness and risk management typically focus on expected scenarios of known magnitudes (Pearson and Mitroff, 1993). Equipping professional organizations with classic tools for new problems might, however, lead to a false sense of security. They may believe they are prepared, but are in fact not (Boin and Lagadec, 2000, p. 185; Taleb, 2010; Alpaslan and Mitroff, 2011). Experience and studies show that what often fails in such situations is how people and organizations work together (Kettl, 2003; Bammer and Smithson, 2009; Schecter and Contractor, 2017, p. 224).

The literature shows that there is an increasing need for intra- and inter-organizational interaction, not least because of several major drivers. Growing interdependencies, rapid technological change, increased expectations for integrated services, increased complexity and uncertainty, including the immediate imperative to respond to crisis and unexpected events (Comfort, 2007; Ansell et al., 2010; Boston and Gill, 2011; Martin et al., 2016; Torgersen, 2018b). The emphasis on interaction comes from a greater recognition that the existing institutional apparatus is not sufficient to handle increasingly complex and ambiguous societal challenges, such as unforeseen events, which in turn challenge patterns of organizations by transcending organizational boundaries (Ansell et al., 2010). Comfort (2007) therefore calls for interconnected responses from organizations.

The term interaction is often used to refer to communication, cooperation, coordination, collaboration, joint action, teamwork, and interplay (Herberg et al., 2018, p. 268). Hence, there are many definitions and overlapping meanings of large or small-scale interaction practices, both at the strategic and the operational level (O'Leary and Vij, 2012; Torgersen, 2018b). The focus is on the joint or collective—working to achieve something together. The different concepts often have similar common usages. They can, however, be differentiated based on the relational level of ambition, degrees of autonomy and integration, or by practical aspects (Selden et al., 2006; Torgersen and Steiro, 2009). At the same time, many people make use of these concepts differently, causing misunderstandings and different expectations with regard to the content of the term and the practical implications (Torgersen, 2018a; p. 25).

From an organizational perspective, the scope and the intensity of interaction stand relevant, merging formal and informal partnership. Based on the depth of shared work, Boston and Gill (2011) have identified the following types of organizational integration: coexisting (shared reliance), communication (shared information), cooperation (shared resources), coordination (shared work), and collaboration (shared responsibilities). Other researchers have also positioned the four dimensions cooperation, coordination, collaboration and service integration in a continuum based on high integration and little autonomy (Selden et al., 2006). From research on crisis management Martin et al. (2016) found important qualitative distinctions between the fours Cs; communication, cooperation, coordination and collaboration. The four terms represent a continuum of increased inter-organizational embeddedness in partnering activities (Martin et al., 2016).

Interaction as a relational phenomenon has a wider relational ambition compared to overall similar relational processes such as coexisting, communications, cooperation, coordination, and collaboration (**Figure 1**). Interaction connotes coexisting, communication, cooperation, coordination, and collaboration in one word. More underlying conditions must be satisfied to achieve interaction in practice than the other terms (Torgersen, 2018a). Torgersen (2018a) argues that interaction in particular emphasizes trust, open and equal communication, shared mental models, development, competence complementarity, common goals, and knowledge. "The underlying processes create the level of ambition and these are important for practice" (Torgersen, 2018a; p. 25).

In essence, this study considers the term interaction to represent the highest level of ambition needed when people are working together under risk and circumstances that are unforeseen (Torgersen, 2018a). The following composite definition of interaction is used in this study: "… an open and equal communication and development process between parties whose competencies complement each other, who exchange competence directly face-to-face, via technology or manually, who work toward a common goal and whose relationship is based on trust, involvement, rationality and industry knowledge"

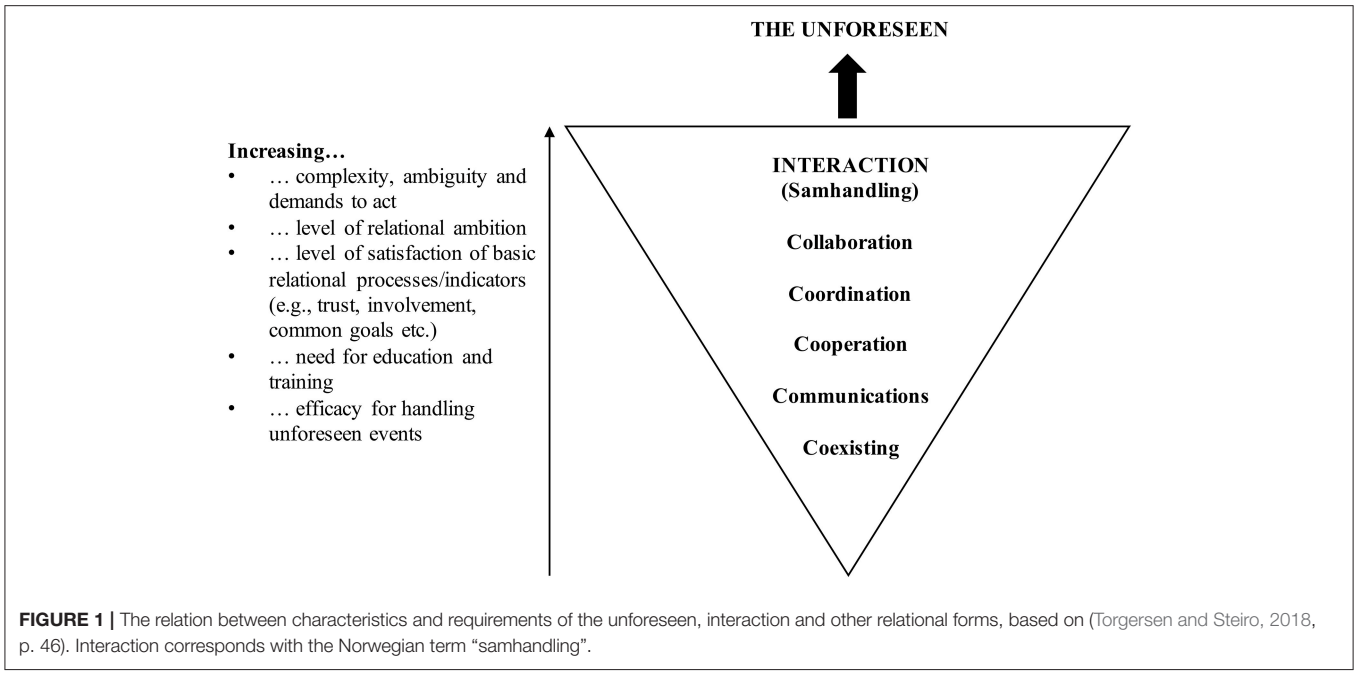

FIGURE 1 | The relation between characteristics and requirements of the unforeseen, interaction and other relational forms, based on (Torgersen and Steiro, 2018, p. 46). Interaction corresponds with the Norwegian term "samhandling".

(translated from Torgersen and Steiro, 2009, p. 130; Torgersen, 2018a, p. 26).

Interaction, despite its advantages, does not necessarily lead to better performance. It is therefore plausible to assume that specific interaction competencies lead to successful interaction (Hao et al., 2017, p. 136). However, there is a need for more knowledge about the basic structures of interaction in a risky and unknown environment (Christensen et al., 2015; Lu and Xue, 2016). Socio-demographics markers such as gender, age and competence level are potential confounding factors which could affect both the basic processes of and the outcome of interaction under risk (Bonanno et al., 2010). Also, a previous study (Herberg et al., 2018) showed that perceived social support, which is moral, emotional, and feedback reassurance (Cobb, 1976; Procidano and Heller, 1983), was associated with interaction under risk. Similarly, other studies show that social support is associated with the ability to cope with stressors, high job demands, adverse conditions, readiness, performance, and personal well-being (Griffith and Vaitkus, 1999; Bliese and Britt, 2001; Cohen, 2004; Armistead-Jehle et al., 2011; Ryan and Burrell, 2012; Delahaij et al., 2016; Herberg et al., 2018). The main aim of this study was to identify components that would allow the better targeting and development of the knowledge and skills that can enhance interaction under risk.

Many interaction studies focus on predictable conditions in which the outcome does not necessarily involve uncertainty and risk (Torgersen, 2018b). Torgersen (2018b) claims that interaction under predictable conditions does not require the same level of attention and precision in knowledge development of underlying processes as in the case of interaction under risk. For more general, competence-related phenomena (in this case, interaction), in a given context (in this case, interaction under risk and unforeseen events), it will be necessary to build competence more specifically. Thus, there is a need for identification and concretization of components that support specific characteristics of interaction, and that embraces both the individual, group, and organizational level. One way to categorize these components is by following cycles related to competence and knowledge flow in organizations (Torgersen and Steiro, 2009; Saeverot, 2017). Torgersen et al. (2018) therefore emphasize three thematic domains in their work to promote research into interaction under risk. These were: education and training (educational structure), organization and leadership (organizational structure), and industry-oriented actions and operations (operational structure). However, the theoretical division and sequence of the three structures and potential associated components have not been measured and tested empirically.

Moreover, the three structures form a framework to categorize a group of nine components (training, concurrent learning, flexibility, improvisation, general preparedness, emergency plans, understanding of the unforeseen, basic capabilities, and identification of risk). These components are rooted in theoretical and practical research related to the unforeseen (Kaarstad and Torgersen, 2017), and cover many aspects of interaction under risk (Torgersen, 2018a). They are developed and evaluated in line with the methodological principles given in Stufflebeam and Shinkfield (2007) and Stufflebeam (2001). Also, interviews, a survey, and a case study were performed to evaluate them (Kaarstad and Torgersen, 2017). The current study aims to examine the three basic structures, and the nine associated components' relationship to interaction under risk.

First, the *educational structure* focuses on how organizations can manage unforeseen events by constructing new insights that shape organization, operation and interaction (Garvin et al., 2008). Especially when it is difficult to fully specify

the consequences and the surprising event itself, this is important. Diversity of knowledge and the continuous development of knowledge and skills, may be essential. Knowledge therefore becomes a key concept in emerging risk as well as black swan type events (Taleb, 2010; Flage and Aven, 2015). There is, despite the widely recognized importance of knowledge as a critical resource in an organization's competitive advantages, "… limited understanding of how to create and manage knowledge dynamically" (Nonaka et al., 2000, p. 6). The core of an organization's educational structure is therefore the development of a continuous strategic process that integrates learning perspectives, learning climate, shared social context, knowledge creation, and knowledge structures (Nonaka and Konno, 1998; Nonaka et al., 2000; Örtenblad, 2002, 2018; Nonaka and Toyama, 2003 Marquardt, 2011).

Training is one component that plays an important role in learning and education (Watkins and Marsick, 1993). Research also shows that the ability to interact under risk may be enhance by training and collaboration exercises, though the effect can be limited and moderate (Berlin and Carlström, 2015; Steigenberger, 2016; Sorensen et al., 2018). Learning occurs where disjuncture, discrepancies, surprises, or challenges act as triggers that stimulate a response (Marsick and Watkins, 2003; Christianson et al., 2009). Training is not, though, the sole distinguishing factor and furthermore does not necessarily imply learning (Antonacopoulou, 1999, 2001; Yeo and Marquardt, 2015). Sorensen et al. (2018) also argue that organizations need to have a stronger emphasis on collaborative learning during training exercises. Hence, organizations that improve and apply concurrent learning, "…" a deliberate and continuously functional and interacting learning process among actors that occurs simultaneously with the interaction" (Steiro and Torgersen, 2018, p. 253), are likely to improve performance by being more proactive, receptive, and adaptable (Marsick and Watkins, 2003; Antonacopoulou and Sheaffer, 2014; Torgersen and Steiro, 2018).

The two components, training and concurrent learning, emphasize in practice the building, and development of complementary skills and knowledge during a working process (Engeström et al., 1999). This is based on a collective experience at the organizational level (Marsick and Watkins, 2003) between humans as social beings within a community of practice (Wenger et al., 2002), in a context in which learning is situated (Lave and Wenger, 1991). Experiential learning (Kolb, 1984), exploration (March, 1991), reflection-in-action (Schön, 1992; Yanow and Tsoukas, 2009), and higher and more advanced levels of learning (see also, Bateson, 1972; Argyris and Schön, 1978, 1996; Hawkins, 1991; Barnett, 2004; Simonin, 2017; Visser et al., 2018) are also important concepts for understanding how new knowledge could be created when people interact under risk and surprise. Consequently, this study is based on the view that learning and interaction occurs in and between every entity (Wang and Ahmed, 2003; Marquardt, 2011)—for the individual in a cognitive way and for the group and organization in a more social and cultural way (Antonacopoulou and Chiva, 2007; Örtenblad, 2018).

Research carried out previously has distinguished between the wide variety of capabilities and competence humans can acquire in their search for ways to facilitate learning and to develop knowledge and skills (Driscoll, 2000; Benner, 2004; Cannon et al., 2010). For example, Benjamin Bloom (1956) introduced the cognitive (later revised by Anderson and Krathwohl, 2001; Krathwohl, 2002), the affective (Krathwohl et al., 1964), and the psychomotor (Harrow, 1972) domains. Gagné (1972) also proposed an integrated taxonomy of five major domains of learning—motor skills, verbal information, intellectual skills, cognitive strategies, and attitudes. The five-stage model for skill acquisition introduced by Dreyfus and Dreyfus (1980) has proven to be useful in many areas, such as in the development of expertise in professions. Dreyfus and Dreyfus' model is based on situated performance and experiential learning, and is extended to complex, under-determined and fast-paced practices (Benner, 2004). For this reason, the model is used in this study for categorizing and grouping the respondents by level of competence. The model describes a person or group as starting off as a novice, becoming competent, then proficient, then expert, and finally master, the highest level (Dreyfus and Dreyfus, 1980, 2005; Dreyfus, 1981; Drejer, 2000). This way of grouping competencies can thus help organizations to adapt education and training for interaction under risk due to competence level.

Most of the research in the field of learning and knowledge acquisition referred to in this study appear to have been firmly established both theoretically and conceptually since the 1960s and 1970s (Visser et al., 2018). There has, however, only been limited research into the measurement, construct validation or empirical investigation of their presence and effects (Huber, 1991; Anderson et al., 1996; Peña, 2010; Noe et al., 2014; Simonin, 2017; Visser et al., 2018). According to Visser et al. (2018, p. 218) "… a field that is rich in conceptualizations, but rather poor in operationalization."

Second, a focal point of the *organizational structure* is interruptions in organizations when normal activity is disturbed by an unexpected event. Flexibility, and through this, absorbed coping in a rapidly evolving external and internal environment, provides the organization with the capacity to manage shock wave effects better (Örtenblad, 2004, p. 139; Yanow and Tsoukas, 2009; Christensen et al., 2016), the objective being to respond promptly to the need for change and to maintain a degree of fit with the environment (Cunha et al., 1999). Organizations that experience unexpected interruptions may, however, have a particular need to improvise (Cunha et al., 2014), situations such as this requiring an immediate response and great situational sensitivity (Cunha et al., 2014). An organization's members need to formulate and execute a plan in real time, using the people and resources available at that point in time (Cunha et al., 1999, p. 302). Improvisation therefore requires the whole organization and its members "… to deal with the unforeseen without the benefit of preparation" (Hadida et al., 2015, p. 440). Not all improvisation is, however, successful and might involve anxiety, risk, and unintended consequences (Cunha et al., 1999, 2014; Giustiniano et al., 2016).

The degree of integration, depth of shared work, and the scope and intensity of partnering activities is of significance to

organizations' ability to interact under risk (Selden et al., 2006; Boston and Gill, 2011; Martin et al., 2016; Torgersen, 2018b). A widespread problem is, however, that participants tend to avoid the best forms of interaction (Berlin and Carlström, 2011), striving instead for stability and favoring routine-based methods, path-dependency, and self-reinforcing behavior (Selznick, 1957; Boin et al., 2005; Christensen et al., 2015). Czarniawska (2009) have furthermore identified the recurrent problem that each failure seems to lead to the conclusion that more plans and structure are needed. This may affect society's and an organization's ability to deal with adverse consequences (Sawalha, 2014), leading to lower levels of flexibility and efficiency (Jung and Song, 2015).

Third, the *operational structure* is characterized by the operative, practical and material value of established components of emergency preparedness. Emergency management is the discipline that deals with risks (Haddow et al., 2017). Risk is defined as assessment of severity of consequence if an adverse event should take place and the probability of such an event (Duijm, 2015, p. 30; Rundmo, 2018). Risk management methodologies include four main steps—risk identification, risk assessment, risk analysis, and risk treatment. These steps guide preparedness, planning, and mitigation processes (Haddow et al., 2017). Haddow et al. (2017) claim that no organization can function without a strong general preparedness capability built up through planning and training, and emergency exercises. It is, however, the realization of these risks that leads to the many different emergency response and recovery institutions implementing their emergency plans and drawing upon their basic capabilities and resources (Haddow et al., 2017). The development of a well-designed emergency plan is considered to be a success factor. It lays the foundation for understanding and practical training, which again develops skills (Steigenberger, 2016) and interaction under risk. Even the best emergency plans and preparations, however, do not seem to always work in the way intended (Comfort, 2007; Czarniawska, 2009; Giustiniano et al., 2016). The dynamic, complex environment of rapidly evolving unforeseen events often causes ambiguity, disorder and interruptions and thus exceeds the capabilities of those conventional emergency components (Comfort, 2007; Van Wart and Kapucu, 2011; Lu and Xue, 2016). Hence, research suggest that the ability to direct joint efforts and operate in the interface between branches and organizations is essential (Van Wart and Kapucu, 2011; Christensen et al., 2015).

There may be a gap between theories of effective interaction under risk and the methodological framework available to articulate and examine potential interaction components. Much of the literature on interaction under risk encourage people and organizations to understand the unforeseen, to identify risk, to learn on the spot, work in teams, give social support, and be flexible and improvise (Yanow and Tsoukas, 2009; Boin and van Eeten, 2013; Hadida et al., 2015; Weick and Sutcliffe, 2015; Herberg et al., 2018). It is not fully investigated how organizations can develop these relevant and basic competencies and so achieve better interaction under risk and unforeseen events. Accordingly, the current research proposes to address this. The study aims to investigate interaction components that individuals and groups evaluate as being important to the management of such conditions. The specific research questions are the following: (1) What is the relationship between components of the basic educational, organizational and operational structures and interaction? (2) Do perceived levels of interaction, social support and components of the three basic structures of interaction under risk differ in terms of competence level, controlling for gender, age, and professional experience? (3) Can competence level group membership be predicted by interaction, social support, and the specified educational and organizational components?

MATERIALS AND METHODS

Procedure

The results of this study are based on a self-completion questionnaire carried out among employees of the Norwegian Armed Forces. The data were collected in the autumn of 2017. The sample includes personnel from all branches of the military and commissioned and non-commissioned officers, military academy students and conscripts. The participants were selected using purposive expert sampling in order to obtain a representative sample of different knowledge and experience from risk and unforeseen events. The questionnaire was distributed to 20 units, departments and military academies throughout Norway. The selection procedure was based on a set of characteristics featuring a representative range of organizational and educational levels, roles and functions within the organization. All the employees within the selected units were asked to participate.

Sample

A total of 917 respondents replied to the questionnaire. The response rate was 87%. The sample included 795 male (87.5%) and 114 female (12.5%) respondents. The mean age was 28.1 years [standard deviation (SD) = 9.4]. The average number of years of military experience of the respondents was 6.6 (SD = 7.2). The questionnaires were completed by pencil and paper in plenum with the researcher present to answer questions if needed. Some questionnaires were supervised by a dedicated department contact person. All participants were, however, given the same introduction to the survey (see also section Ethics Statement).

Measures

Social support was measured using a modified 10-item version (Glozah and Pevalin, 2017) of the Perceived Social Support (PSS) Scale (Procidano and Heller, 1983). For this study, the revised measurement consists of two similar self-reported indices consisting of 10 items each. They measured perceived social support from leaders and fellow colleagues. A five-point Likert scale ranging from "strongly disagree" to "strongly agree" was used for the measurements. The reliability and the internal consistency of the indices were found to be satisfactory. Cronbach's alpha for scale dimensions were for social support by colleagues, $\alpha = 0.871$, and for social support by leader, $\alpha = 0.887$.

The UN-ORG (UNforeseen Organization) Questionnaire consists of a total of 87 items grouped in 10 categories. The purpose of the questionnaire is to poll employees in an organization to assess the extent to which they believe their

organization has an emergency preparedness that can handle unforeseen events (Kaarstad and Torgersen, 2017). The reliability and internal consistency of the questionnaire, including all items, has previously resulted in a satisfactory value of Cronbach's α = 0.900 (Kaarstad and Torgersen, 2017). The questionnaire was used to measure interaction, training, concurrent learning, flexibility, improvisation, general preparedness, emergency plans, understanding of the unforeseen (UN), basic capabilities, and identification of risk. **Table 1** shows that all the subscales that measure these constructs had satisfactory reliabilities and internal consistencies.

Statistical Analysis

SPSS (version 24.0) was used to carry out statistical analysis (Chicago: SPSS Inc.). Preliminary analyses were performed to ensure that the assumptions of normality, linearity, multicollinearity and homoscedasticity in the indices were not violated (Tabachnick and Fidell, 2013). The Perceived Social Support Scale (PSS) and the Unforeseen Organization Questionnaire (UN-ORG) items were subjected to principal component analysis (PCA). Cattell's (1966) scree tests for visual inspection of the scree plots were carried out to indicate which components should be retained. This was further supported by the Monte Carlo PCA for Parallel Analysis results, to decide which components had eigenvalues exceeding the criterion values for a randomly generated data matrix for variables of the same quantity and the same number of respondents (Watkins, 2000). Cronbach's α was calculated to examine scale reliability and the internal consistency of the indices (Cortina, 1993). Average corrected item-total correlation and factor loadings were determined to provide additional information on the scales' factorial structures (Costello and Osborne, 2005). k-Means cluster analysis was carried out to explore and identify reasonably homogenous competence groups of cases in the data (Scott and Knott, 1974; Jain, 2010). A variable that reflects competence level was first computed using the respondent's civilian education, military education, service position, role in the organization and unit affiliation. Pearson's *r* correlation coefficients were estimated to analyze the association between the study variables.

A hierarchical multiple regression analysis was used to examine predictors of interaction. The predictor variables were entered block-wise. Gender, age, years of experience and competence level were entered as control variables. Consequently, the first block consisted of these variables. The second consisted of social support by colleagues and social support by leader, the third of educational structure (training and concurrent learning), the fourth of organizational structure (flexibility and improvisation), and the final block was operational structure (general preparedness, emergency plan, understanding of the UN, basic capabilities and identification of risk). Social support was, based on previous results (Herberg et al., 2018), entered next. The remaining predictors were organized in educational, organizational and operational structures, and entered in that order based on the theoretical construct of Torgersen et al. (2018).

A one-way analysis of variance (ANOVA) was conducted to examine differences in interaction due to competence level. Participants were classified into five groups: novice, competent, proficient, expert and master levels of competence. Tukey HSD (Bonferroni) *post-hoc* test was applied to investigate which of the groups there were significant differences between. The strength of the differences was examined by using Cohen's d_z (Lakens, 2013). A multivariate analysis of covariance (MANCOVA) was carried out to examine differences in interaction, social support and the educational, organizational and operational structures due to competence level, gender, age and years of experience (Tabachnick and Fidell, 2013). A multinomial logistic regression finally assessed whether competence levels and group membership could be predicted by interaction, social support and the specified educational and organizational factors (Hosmer et al., 2013).

RESULTS

Component Analysis and Parameter Estimate of Measures

Table 2 shows that Perceived Social Support Scale (PSS) consisted of two dimensions. The first was entitled social support—colleagues and the second social support—leader. The factors training and concurrent learning of the UN-ORG Questionnaire showed a two-component solution. First, the components of training were entitled training—decision making and training—unknown. Second, the components of concurrent learning were entitled concurrent learning—construction and concurrent learning—reflection. A two-component solution on social support, training and concurrent learning also met the interpretability criterion (at least 3 items, items of the same component measure, the same factor, items loading on different components, and the rotated factor pattern). Two items on each of the dimensions were removed from the Perceived Social Support (PSS) Scale due to low factor loadings and factor structure (Costello and Osborne, 2005). The cut-off value was set at 0.40. A Direct Oblimin oblique rotation was used to aid interpretability, the rotated solution revealing the presence of simple structures (Osborne, 2015).

One component was extracted for all of the eight other factors of the UN-ORG Questionnaire. No items were removed. The interpretation of the data was consistent with the attributes the questionnaire was designed to measure (Kaarstad and Torgersen, 2017). The results, including parameter estimates of average corrected item-total correlation and factor loadings, were reasonable and support the educational, organizational and operational structures for interaction under risk. Thus, a PCA of the 11 extracted independent variables from the UN-ORG Questionnaire indicated a three-component solution that explained 72.1% of the variance. Oblimin rotation was performed, the KMO was 0.91 (Kaiser, 1974), and Bartlett's test of sphericity reached statistical significance (Bartlett, 1954).

Competence Level Cluster Groups and Intercorrelations

A k-Means cluster analysis was conducted to identify cluster group membership due to competence (Jain, 2010). **Figure 2**

TABLE 1 | Descriptions, example items, number of items, Cronbach's alpha, and corrected item-total correlation for the Unforeseen organization (UN-ORG) Questionnaire.

Variable	Description	Example questionnaire items	No. of items	α	Corr. item-total correlation
Interaction	*The organization's ability*… to manage relational forms internally and externally	*My organization*… has developed a good level of employee trust	7	0.774	0.50
Training—decision-making	… to continuous competence development and training programs	… trains in taking decisions in dilemma situations	7	0.889	0.68
Training—unknown	… to emphasis on training for unforeseen situation	… trains in dealing with unfamiliar situations apart from the fixed solutions	4	0.738	0.53
Concurrent learning—construction	… to emphasis critical observation and communication during events	… trains in sharing with others and utilizing relevant details during events	6	0.782	0.54
Concurrent learning—reflection	… to reflect in in the midst of adverse situations	… stops during actual events to get an overview of the situation	4	0.756	0.56
Flexibility	…and willingness to adapt	… can easily adapt its structure during an event	5	0.768	0.55
Improvisation	… to find new solutions for new problems	… has the ability to be spontaneous and to be innovative during unforeseen events	7	0.848	0.61
General preparedness	… to mitigate, plan and prepare for various threats and risks	… has plans for education and training in emergency preparedness	20	0.932	0.62
Emergency plans	… to use existing plans for management and prevention	… is familiar with the contents of emergency preparedness plans, which focus on the unforeseen	7	0.841	0.60
Understanding of the unforeseen (UN)	…to perceive, describe and define	… has the unforeseen as a fixed item in security training	7	0.754	0.48
Basic capabilities	… to mobilize and facilitate resources and capabilities	… masters the use of the equipment which it is assumed is needed to handle unforeseen events	7	0.810	0.55
Identification of risk	… to identify and pursue warning signs	… evaluates the significance of signs that are not immediately considered to indicate serious events	6	0.828	0.60

shows k-Means clustering of the 917 subjects scores for the five competence variables (see also section Statistical Analysis). The analysis showed that five competence cluster groups were partitioned and clearly distinguishable. This, according to the theoretical framework of Dreyfus and Dreyfus (1980), therefore apportioned the participants in this study into five groups according to their competence level; group 1—novice, group 2—competent, group 3—proficient, group 4—expert, group 5—master.

Table 3 shows the associations between the predictor variables and the outcome variable (Pearson's r correlation coefficients). As expected, most of the variables were positively associated with each other in the moderate and weak range (Cohen, 1988). The strongest significant correlation coefficients of the outcome variable interaction and the predictors were between concurrent learning—construction and interaction, $r = 0.57$, $n = 906$, $p < 0.001$, concurrent learning—reflection and interaction, $r = 0.51$, $n = 906$, $p < 0.001$, and basic capabilities and interaction, $r = 0.55$, $n = 906$, $p < 0.001$. The socio-demographic variables of age, years of experience, and competence level were significantly associated. No symptoms of multicollinearity were detected (Tabachnick and Fidell, 2013).

Predictors of Interaction Under Risk

A hierarchical multiple regression was conducted to predict interaction under risk. Gender, age, years of professional experience and competence level were entered as control variables in block 1. Social support was the second block, the four educational structure components were entered in block three, the two organizational structure components in block four, and the five operational structure components in block five. The full details on each regression model are shown in **Table 4**. In addition, Pearson's r correlation coefficients between each predictor and the dependent variable are reported in **Table 3.**

The results showed that the model accounted for 58.7% of variance in interaction under risk. Socio-demographic variables contributed significantly and accounted for 4.8% of the variance in interaction under risk, $R^2 = 0.048$, $F_{(10,801)} = 10.80$, $p < 0.001$. The two social support components explained an additional 25.4% of the variance, $R^2 = 0.254$, F change $_{(2,846)} = 154.09$, $p < 0.001$. The addition of four educational components explained an additional 19.9%, $R^2 = 0.199$, F change $_{(4,842)} = 83.89$, $p < 0.001$. The addition of two organizational components explained a further 4.2% of the variance, $R^2 = 0.042$, F change $_{(2,840)} = 38.66$, $p < 0.001$. Finally, the adding of five operational components explained an additional 4.4% of variance in interaction under risk, $R^2 = 0.044$, F change $_{(5,835)} = 17.85$, $p < 0.001$.

In the final model, social support ($ß = 0.18$, $p < 0.001$) ($ß = 0.13$, $p < 0.001$), concurrent learning ($ß = 0.13$, $p < 0.001$) ($ß = 0.09$, $p < 0.01$), and basic capabilities ($ß = 0.14$, $p < 0.001$) were the components which significantly added most variance to interaction under risk. The analysis showed that neither gender ($ß = -0.02$, ns), years of experience ($ß = 0.02$, ns),

TABLE 2 | Mean, standard deviation, Kaiser-Meyer-Olkin Measure, Bartlett's test, total variance explained, and factor loadings for the study variables.

Study variables	Mean	*SD*	*KMO*	Bartlett's test	Total variance explained (%)	Factor loadings
Interaction	3.65	0.54	0.81	<0.0005	43.4	0.55,0.74
Social support	3.67	0.57	0.92	<0.0005	56.6	0.46,0.75
Social support—colleagues	3.90	0.60			12.9	0.66,0.80
Social support—leader	3.44	0.70			43.7	0.62,0.85
Training	3.68	0.64	0.91	<0.0005	59.3	0.56,0.80
Training—decision-making	3.83	0.69			49.7	0.62,0.88
Training—unknown	3.41	0.71			12.6	0.54,0.86
Concurrent learning	3.67	0.54	0.87	<0.0005	52.8	0.56,0.73
Concurrent learning—construction	3.69	0.58			41.5	0.57,0.81
Concurrent learning—reflection	3.64	0.65			11.2	0.67,0.82
Flexibility	3.55	0.62	0.76	<0.0005	52.8	0.68,0.77
Improvisation	3.71	0.63	0.87	<0.0005	53.3	0.65,0.82
General preparedness	3.60	0.62	0.94	<0.0005	44.4	0.54,0.73
Emergency plans	3.26	0.63	0.89	<0.0005	52.3	0.60,0.81
Understanding of the unforeseen (UN)	3.17	0.61	0.84	<0.0005	42.0	0.47,0.75
Basic capabilities	3.40	0.63	0.75	<0.0005	47.6	0.59,0.78
Identification of risk	3.25	0.62	0.81	<0.0005	54.3	0.65,0.79

N = 905–907; SD, standard deviation; KMO, Kaiser-Meyer-Olkin Measure.

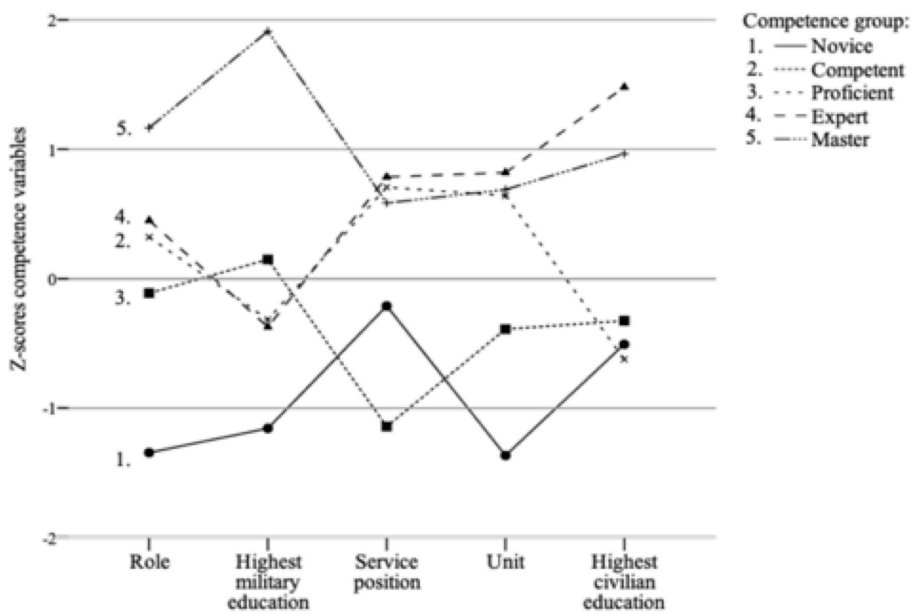

FIGURE 2 | Competence variables scores due the five competence groups (Z-scores). *N* = 917. Number of cases in each cluster: novice (*n* = 107), competent (*n* = 267), proficient (*n* = 227), expert (*n* = 171), master (*n* = 145).

competence level ($\beta = 0.03$, ns), training—unknown ($\beta = -0.05$, ns), understanding of the UN ($\beta = 0.01$, ns) and identification of risk ($\beta = 0.02$, ns) were significant predictors of interaction under risk.

The results, with regard to the first research question of the current study, showed that the psychological factors of social support and the educational structure components in particular are associated with interaction under risk and unforeseen events.

Competence Level Differences in Preparedness Variables of Unforeseen Events

Differences in Interaction Due to Participants Competence Level

Figure 3 shows that interaction mean scores were different for the five groups of different competence level (novice, competent, proficient, expert and master). The difference between these

TABLE 3 | Intercorrelations for socio-demographics, predictors and criterion.

Measure	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
SOCIO-DEMOGRAPHIC VARIABLES																		
(1) Gender	_																	
(2) Age	0.15**	_																
(3) Years of experience	0.12**	0.79**	_															
(4) Competence level	0.11**	0.78**	0.66**	_														
PREDICTOR VARIABLES																		
(5) Social suppose—colleagues	−0.05	−0.09*	−0.07*	−0.03	_													
(6) Social suppose—leader	0.08*	0.05	0.03	0.04	0.53**	_												
(7) Training—decision-making	−0.03	−0.30**	−0.20**	−0.24**	0.35**	0.19**	_											
(8) Training—unknown	−0.03	−0.17**	−0.11**	−0.11**	0.23**	0.23**	0.65**	_										
(9) Concurrent learning—construction	−0.03	−0.22**	−0.14**	−0.15**	0.33**	0.28**	0.63**	0.59**	_									
(10) Concurrent learning—reflection	−0.02	−0.13**	−0.07	−0.01	0.28**	0.31**	0.45**	0.44**	0.57**	_								
(11) Flexibility	0.01	0.03	0.03	0.07	0.23**	0.33**	0.35**	0.46**	0.46**	0.42**	_							
(12) Improvisation	0.04	0.01	0.01	0.04	0.32**	0.33**	0.39**	0.43**	0.45**	0.34**	0.60**	_						
(13) General preparedness	−0.02	0.02	0.02	0.09*	0.11**	0.30**	0.25**	0.51**	0.45**	0.38**	0.53**	0.42**	_					
(14) Emergency plans	0.00	−0.02	−0.01	0.00	0.13**	0.27**	0.31**	0.52**	0.44**	0.37**	0.49**	0.38**	0.77**	_				
(15) Understanding of the UN	−0.04	−0.14**	−0.11**	−11**	0.15**	0.25**	0.42**	0.56**	0.48**	0.38**	0.44**	0.39**	0.63**	0.72**	_			
(16) Basic capabilities	−0.01	−0.11**	−0.09*	0.00	0.18**	0.25**	0.37**	0.49**	0.48**	0.42**	0.53**	0.48**	0.62**	0.57**	0.57**	_		
(17) Identification of risk	−0.04	−0.03	−0.06	−0.03	0.18**	0.29**	0.31**	0.51**	0.45**	0.40**	0.45**	0.33**	0.61**	0.64**	0.60**	0.51**	_	
OUTCOME VARIABLE																		
(18) Interaction	−0.04	−0.19**	−0.14**	−0.09*	0.43**	0.45**	0.48**	0.47**	0.57**	0.51**	0.50**	0.49**	0.50**	0.50**	0.49**	0.55**	0.46**	_

*N = 887–917. Gender was coded 1 = female, 2 = male. **Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed).*

TABLE 4 | Summary of hierarchical multiple regression analysis with interaction as criterion.

Block and predictor variable	Block 1	Block 2	Block 3	Block 4	Block 5
	β	β	β	β	β
BLOCK 1: SOCIO-DEMOGRAPHICS					
Gender	−0.01	−0.03	−0.02	−0.03	−0.02
Age	−0.34***	−0.28***	−0.12*	−0.15**	−0.15**
Years of experience	0.03	0.03	0.01	0.00	0.02
Competence level	0.17**	0.11*	0.08*	0.06	0.03
BLOCK 2: PSYCHOLOGICAL FACTORS					
Social support colleagues		0.26***	0.15***	0.15***	0.18***
Social support leader		0.32***	0.21***	0.16***	0.13***
BLOCK 3: EDUCATIONAL STRUCTURE					
Training—decision-making			0.07	0.06	0.10**
Training—unknown			0.13***	0.06	−0.05
Concurrent learning—construction			0.25***	0.19***	0.13***
Concurrent learning—reflection			0.16***	0.13***	0.09**
BLOCK 4: ORGANIZATIONAL STRUCTURE					
Flexibility				0.17***	0.08*
Improvisation				0.12***	0.09**
BLOCK 5: OPERATIONAL STRUCTURE					
General preparedness					0.11**
Emergency plans					0.08*
Understanding of the unforeseen					0.01
Basic capabilities					0.14***
Identification of risk					0.02
R^2	0.05	0.30	0.50	0.54	0.59
ΔR^2	0.05	0.25	0.20	0.04	0.04
ΔF	10.80***	154.09***	83.89***	38.66***	17.85***

*N = 853. Listwise deletion. *p < 0.05, **p < 0.01, ***p < 0.001.*

competence level groups were statistically significant at the $p < 0.05$ level: $F_{(4, 902)} = 16.05$, $p = 0.001$. The interaction score decreased from novice ($M = 3.85$, $SD = 0.55$) to competent ($M = 3.55$, $SD = 0.51$), increased to proficient ($M = 3.69$, $SD = 0.49$), decreased to expert ($M = 3.43$, $SD = 0.56$) increased to master ($M = 3.75$, $SD = 0.49$) competence level groups, in that order. **Figure 3** also shows that the actual differences in mean scores between the groups were small, $\text{Eta}^2 = 0.07$.

Post-hoc comparisons using Tukey HSD and Bonferroni tests showed that the mean score for the novice group ($M = 3.85$, $SD = 0.55$) was significantly different from the competent ($M = 3.55$, $SD = 0.51$, $d = 0.56$), the proficient ($M = 3.69$, $SD = 0.49$, $d = 0.30$), and the expert ($M = 3.44$, $SD = 0.56$, $d = 0.75$) groups. The proficient group ($M = 3.69$, $SD = 0.49$) was significantly different from the competent ($M = 3.55$, $SD = 0.51$, $d = 0.28$), and the expert ($M = 3.44$, $SD = 0.56$, $d = 0.50$) groups. The master group ($M = 3.75$, $SD = 0.49$) was significantly different from the competent ($M = 3.55$, $SD = 0.51$, $d = 0.39$) and the expert ($M = 3.44$, $SD = 0.56$, $d = 0.59$) groups. Thus, the effect size for this analysis ranged from a small to medium, medium, and medium to large effect (Cohen, 1988).

Effectiveness of Competence Level and Socio-Demographics on Preparedness

Next the impact of competence level was examined. The independent variables were competence level groups (novice, competent, proficient, expert, and master) and gender. The dependent variables were interaction, social support, and the eleven components of the educational, organizational, and operational structures. Age and years of experience were entered as covariates to control for the influence of these variables. The results in **Table 5** show a statistically significant overall difference, $F_{(56, 3, 223)} = 3.61$, $p < 0.001$, Wilks' $\lambda = 0.79$, partial $\eta^2 = 0.06$, in the competence level groups on the combined dependent variables after controlling for gender, age, and years of experience. There was, however, no statistically significant relationship between level of competence and gender, $F_{(56, 3, 223)} = 0.99$, $p = 0.49$, Wilks' $\lambda = 0.94$, partial $\eta^2 = 0.02$. The univariate test, though, showed there was a small statistically significant difference in social support—leader scores of males and females, $F_{(1, 841)} = 4.92$, $p < 0.05$, partial $\eta^2 = 0.01$. The covariate age significantly influenced the combined dependent variables, $F_{(14, 828)} = 3.55$, $p < 0.001$, Wilks' $\lambda = 0.94$, partial $\eta^2 = 0.06$.

The multivariate effect of competence level groups on interaction $F_{(11, 841)} = 5.63$, $p < 0.001$, $\eta^2 = 0.07$, social

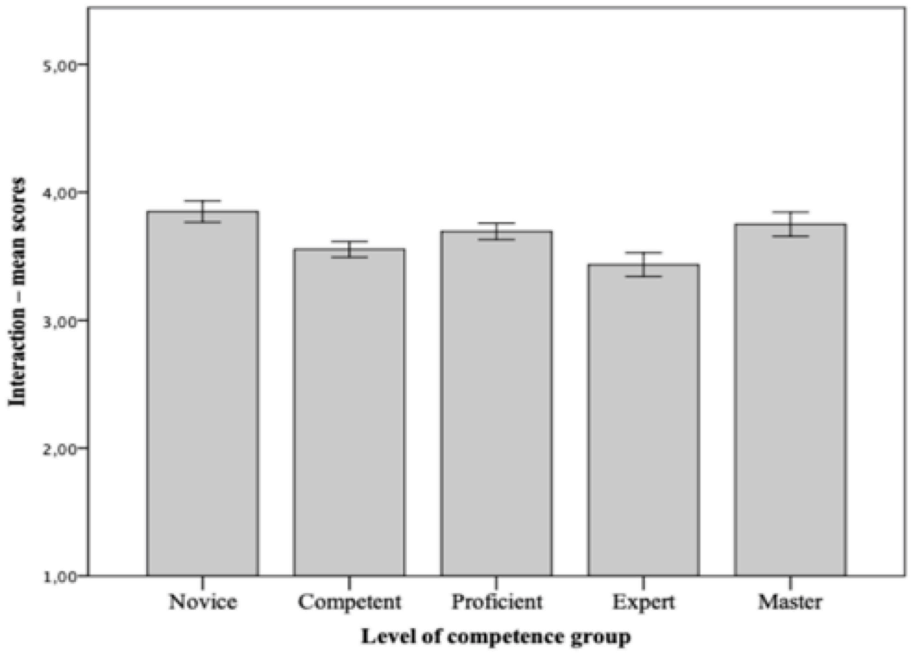

FIGURE 3 | Differences in interaction due to level of competence group. $N = 907$. Novice ($n = 169$), competent ($n = 262$), proficient ($n = 226$), expert ($n = 143$), master ($n = 107$). Error bars: 95% confidence intervals.

support—colleagues $F_{(11,841)} = 3.05$, $p < 0.01$, $\eta^2 = 0.04$, and social support—leader $F_{(11,841)} = 2.98$, $p < 0.01$, $\eta^2 = 0.04$ were significant. **Table 5** also shows that competence level groups revealed a significant effect on all the 11 components of the educational, organizational, and operational structures. General preparedness, $F_{(11,841)} = 19.84$, $p < 0.001$, $\eta^2 = 0.21$, emergency plan, $F_{(11,841)} = 12.62$, $p < 0.001$, $\eta^2 = 0.14$, understanding of the unforeseen, $F_{(11,841)} = 8.96$, $p < 0.001$, $\eta^2 = 0.11$, training—decision-making, $F_{(11,841)} = 8.36$, $p < 0.001$, $\eta^2 = 0.10$, and identification of risk, $F_{(11,841)} = 7.94$, $p < 0.001$, $\eta^2 = 0.09$, demonstrated the strongest significant effect. As such, considering research question two, the results showed that the respondent's level of competence had an effect on all the 14 combined dependent variables, irrespective of gender.

Prediction of Respondents Competence Level Group Membership

A multinomial logistic regression analysis was used to investigate the relationships between interaction, social support and the set of educational, organizational, and operational components for membership of the five competence level groups (novice, competent, proficient, expert and master). The reference category for the outcome variable was *novice*. The focus of this analysis was on predicting the likelihood of respondent's competence group membership. The goodness of fit of the final model was significant, $\chi^2_{(40,\ N=894)} = 382.093$, $p < 0.001$. The model also predicted the dependent variable over and above the intercept-only model. The Pearson goodness-of-fit test indicated that the model was a good fit to the observed data, $\chi^2_{(3,532)} = 3573.292$, $p = 0.309$, and Nagelkerke $R^2 = 0.36$, $p < 0.001$.

Each variable was compared with the full model to determine whether it should be included in the final model (**Table 6**). Predictor variables without significant unique effects or that caused poor model fit were excluded. The other operational structure components, except for understanding of the UN, were omitted. It seems that these factors relate to other and more specific and material parts of the preparedness processes, for example planning and equipment. The remaining predictors in the final model, however, showed a significant unique contribution or contributed meaningfully to the full effect, as shown in **Table 6**.

Social support—colleagues ($OR = 2.41$) and training—decision-making ($OR = 7.32$) significantly increased the probability of membership of the competent group compared with *novice*. Interaction ($OR = 0.33$), training—unknown ($OR = 0.39$), concurrent learning—construction ($OR = 0.51$), and understanding of the UN ($OR = 0.19$) however decreased the odds of being a member of the competent group. The second column in the table compares the *proficient* result with *novice*. The results showed that interaction ($OR = 0.44$), concurrent learning—construction ($OR = 0.81$), and understanding of the UN ($OR = 0.34$) were associated with a decrease in the odds of being a member of the proficient group. The third column in **Table 6** compares the result of *expert* with *novice*. The analysis showed that participants who reported higher levels of flexibility ($OR = 2.18$) and improvisation ($OR = 1.88$) were significantly more likely to be members of the expert competence group. The levels of interaction ($OR = 0.20$), training—unknown ($OR = 0.58$) and understanding of the UN ($OR = 0.29$) however significantly decreased the probability. The final column

TABLE 5 | Mean, standard deviation, adjusted mean, standard error, multivariate and univariate analyses of covariance results for interaction, social support and interaction under risk structures due to competence level and gender, with age, and years of experience as covariates.

Variable	Competence level group										*F (obs.)*	*F (exp.)*
	Novice[a]		Competent[b]		Proficient[c]		Expert[d]		Master[e]			
	M (SD)	$M_{adj.}$ *(SE)*	*M (SD)*	$M_{adj.}$*(SE)*	*M (SD)*	$M_{adj.}$*(SE)*	*M (SD)*	$M_{adj.}$*(SE)*	*M (SD)*	$M_{adj.}$ *(SE)*		
Interaction	3.85 (0.56)	3.80 (0.06)	3.56 (0.51)	3.56 (0.05)	3.69 (0.49)	3.70 (0.07)	3.45 (0.55)	3.54 (0.09)	3.75 (0.50)	3.83 (0.09)	5.63***	4.14**
Social support colleagues	3.85 (0.72)	3.79(0.07)	4.00 (0.54)	4.02 (0.06)	3.92 (0.58)	3.93 (0.07)	3.74 (0.55)	3.78 (0.10)	3.92 (0.57)	4.00 (0.10)	3.05**	2.52*
Social support leader	3.47 (0.71)	3.41 (0.08)	3.31(0.73)	3.26 (0.07)	3.52 (0.68)	3.43 (0.09)	3.38 (0.70)	3.24 (0.12)	3.68 (0.63)	3.66 (0.11)	2.98**	2.88*
EDUCATIONAL STRUCTURE COMPONENTS												
Training—decision-making	3.93 (0.68)	3.86 (0.08)	4.04 (0.59)	3.98 (0.06)	3.84 (0.71)	3.96 (0.08)	3.53 (0.66)	3.64 (0.11)	3.58 (0.73)	3.57 (0.11)	8.36***	3.53**
Training—unknown	3.67 (0.69)	3.63 (0.08)	3.29 (0.71)	3.32 (0.07)	3.44 (0.66)	3.47 (0.09)	3.22 (0.73)	3.29 (0.12)	3.43 (0.65)	3.43 (0.11)	3.88***	2.88*
Con. learn.—construction	3.88 (0.63)	3.82 (0.07)	3.64 (0.52)	3.60 (0.05)	3.75 (0.56)	3.78(0.07)	3.54 (0.53)	3.63 (0.10)	3.59 (0.62)	3.67 (0.09)	4.20***	2.33
Con. learn.—reflection	3.73 (0.61)	3.66 (0.08)	3.59 (0.63)	3.51 (0.06)	3.69 (0.69)	3.75 (0.08)	3.51 (0.65)	3.63 (0.11)	3.79 (0.62)	3.89 (0.11)	2.46**	2.84*
ORGANIZATIONAL STRUCTURE COMPONENTS												
Flexibility	3.65 (0.59)	3.63 (0.07)	3.35 (52)	3.40 (0.06)	3.62 (0.66)	3.57 (0.08)	3.59 (0.63)	3.65 (0.10)	3.68 (0.59)	3.64 (0.10)	4.14***	2.63*
Improvisation	3.78 (0.69)	3.77 (0.08)	3.56 (0.58)	3.49 (0.06)	3.79 (0.66)	3.77 (0.08)	3.73 (0.66)	3.74 (0.11)	3.77 (0.55)	3.80 (0.10)	2.04*	3.71**
OPERATIONAL STRUCTURE COMPONENTS												
General preparedness	3.90 (0.51)	3.90 (0.07)	3.18 (0.55)	3.24 (0.05)	3.67 (0.60)	3.67 (0.07)	3.66 (0.50)	3.73 (0.09)	3.86 (0.59)	3.81 (0.09)	19.84***	20.67***
Emergency plans	3.58 (0.54)	3.58 (0.07)	2.94 (0.54)	3.00 (0.06)	3.34 (0.60)	3.24 (0.07)	3.25 (0.58)	3.28 (0.10)	3.40 (0.69)	3.29 (0.10)	12.62***	12.32***
Understanding of the UN	3.52 (0.54)	3.45(0.07)	2.96 (0.54)	2.98 (0.06)	3.21 (0.58)	3.17 (0.07)	3.05 (0.62)	3.09 (0.10)	3.23 (0.64)	3.26 (0.09)	8.96***	8.48***
Basic capabilities	3.61 (0.60)	3.57 (0.07)	3.22 (0.59)	3.17 (0.06)	3.40 (0.65)	3.37 (0.08)	3.33 (0.66)	3.55 (0.10)	3.57 (0.59)	3.57 (0.10)	5.08***	6.90***
Identification of risk	3.52 (0.54)	3.54 (0.07)	3.01 (0.60)	3.09 (0.06)	3.28 (0.59)	3.26 (0.08)	3.17 (0.58)	3.27 (0.10)	3.39 (0.64)	3.36 (0.10)	7.94***	7.24***

$N = 853$; Wilks' $\lambda = 0.79$, $F_{(56,3223)} = 3.61$, $p < 0.001$, $\eta^2 = 0.06$. Con. learn., Concurrent learning; F (obs.), F observed; F (exp.), F expected.

[a]$n = 144$.

[b]$n = 250$.

[c]$n = 220$.

[d]$n = 133$.

[e]$n = 106$.

*M, mean; SD, standard deviations; Madj., adjusted mean; SE, standard error. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. Listwise deletion.*

TABLE 6 | Summary of logistic regression analysis predicting competence membership.

Variable	Competent (n = 256)			Proficient (n = 225)			Expert (n = 140)			Master (n = 107)		
	B	SE	OR [95% CI]	B	SE	OR [95% CI]	B	SE	OR [95% CI]	B	SE	OR [95% CI]
Interaction	−1.10	0.32	0.33 [0.18, 0.62]**	−0.82	0.31	0.44 [0.24, 0.80]**	−1.62	0.35	0.20 [0.10, 0.39]***	−0.20	0.38	0.82 [0.39, 1.72]
Social support colleagues	0.88	0.25	2.41 [1.49, 3.90]***	0.32	0.23	1.37 [0.88, 2.15]	0.15	0.26	1.16 [0.70, 1.93]	0.07	0.30	1.08 [0.60, 1.93]
Social support leader	−0.19	0.21	0.83 [0.55, 1.23]	0.21	0.20	1.23[0.82, 1.83]	0.21	0.23	1.24 [0.78, 1.95]	0.71	0.27	2.04 [1.20, 3.46]**
Training—decision-making	1.99	0.28	7.32 [4.20, 12.75]***	0.47	0.26	1.60 [0.96, 2.67]	0.05	0.28	1.05 [0.60, 1.83]	−0.58	0.31	0.56 [0.30, 1.03]
Training—unknown	−0.94	0.25	0.39 [0.24, 0.64]***	−0.55	0.25	0.58 [0.36, 0.93]	−0.55	028	0.58 [0.34, 1.00]*	0.03	0.31	1.03 [0.56, 1.88]
Con. learn.—construction	−0.67	0.31	0.51 [0.28, 0.94]*	−0.21	0.29	0.81 [0.46, 1.44]*	−0.29	0.33	0.75 [0.39, 1.43]	−1.23	0.36	0.29 [0.15, 0.59]**
Con. learn.—reflection	0.41	0.23	1.50 [0.97, 2.33]	0.34	0.22	1.40 [0.92, 2.14]	0.32	0.25	1.38 [0.85, 2.23]	0.98	0.28	2.67 [1.55, 4.59]***
Flexibility	−0.09	0.24	0.91 [0.57, 1.47]	0.31	0.24	1.37 [0.86, 2.18]	0.78	0.29	2.18 [1.24, 3.83]**	0.45	0.31	1.57 [0.86, 2.86]
Improvisation	0.05	0.24	1.05 [0.66, 1.68]	0.42	0.23	1.52 [0.97, 2.40]	0.63	0.27	1.88 [1.11, 3.20]*	0.36	0.29	1.43 [0.81, 2.53]
Understanding of the UN	−1.67	0.26	0.19 [0.11, 0.31]***	−1.09	0.24	0.34 [0.21, 0.54]***	−1.23	0.28	0.29 [0.17, 0.51]***	−0.94	0.30	0.39 [0.22, 0.70]**

*N = 894. The reference category is: novice (n = 166). SE, standard error; OR, odds ratio; CI, confidence interval; Con. learn., Concurrent learning. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.*

compares the result of *master* with *novice*. Respondents with higher levels of social support by leader ($OR = 2.04$) and concurrent learning—reflection ($OR = 2.67$) were significantly predicted to be members of the master competence group. However, the outcome of concurrent learning—construction ($OR = 0.29$) and understanding of the UN ($OR = 0.39$) significantly reduced the likelihood of membership of the master competence group. In sum, with attention to research question three, the results specified that different components (interaction, social support, training, concurrent learning, flexibility, improvisation and understanding of the UN) increased the likelihood of membership in a certain competence group.

DISCUSSION

The current study investigated the effects of basic educational, organizational and operational components (including social support) on interaction under risk. Previous theory and empirical studies led to the assumption that there could be a relationship between educational, organizational and operational structures and the ability to interact under unforeseen events (Örtenblad, 2004; Czarniawska, 2009; Cunha et al., 2014; Hadida et al., 2015; Steigenberger, 2016; Haddow et al., 2017; Steiro and Torgersen, 2018; Torgersen, 2018a). The current study also hypothesized that interaction, social support and the components of the interaction under risk-structures would be associated with competence level and competence group membership (Dreyfus and Dreyfus, 1980, 2005; Dreyfus, 1981; Benner, 2004).

The results showed that social support and concurrent learning significantly predicted interaction under risk. The results also demonstrated significant differences and the effectiveness of respondent's competence level on interaction, social support, and the components of the three basic structures of interaction under risk. Finally, the results showed that competence level group membership was associated with interaction, social support, and the specified educational and organizational components.

The findings of this study propose that organizations need to match up the traditional measures of emergency preparedness with focus upon social support, concurrent learning, decision-making in dilemma situations, organizational improvisation, and flexibility, all promoting the ability of interaction under risk. The combined set of predictor variables (social support, training, concurrent learning, flexibility, improvisation, general preparedness, emergency plans, and basic capabilities) accounted for 58.7% of the variance in interaction. Combining hierarchy and networks in a mix of central governance and self-synchronization is often a challenge for organizations confronted with transboundary, ambiguous and complex conditions (Ansell et al., 2010; Christensen et al., 2016). Subject to the degree of uncertainty, uniqueness, and transboundary features (Christensen et al., 2016), interaction efforts can be an effective response to unforeseen events (Ansell et al., 2010). Hence, a composite of the components associated with interaction under risk might be a promising way forward. The findings also show that it is possible to differentiate and target

educational and training efficiency by competence level. Even so, there may be need for educational models and training programs that facilitate knowledge creation. To the authors of this current study's knowledge, there are no previous studies that have concurrently examined the educational, organizational and operational structures examined in this study and the relation of these to competence levels.

Implications

The current study with regard to the research questions hold theoretical and practical implications. First, the results show that social support may be important when responding to threats which the individual lacks the competence to handle. An individual's perception of the receipt of emotional and moral support, and the receipt of feedback and information from colleagues and leaders (Procidano and Heller, 1983), may be important to interaction under risk (Herberg et al., 2018). An emphasis on the building of working conditions to promote high levels of social support should therefore, be prioritized.

The results furthermore showed that concurrent learning promotes the ability to interact under risk. Individuals who experience a disruptive event and have the capacity to get an overview and to see the details in the situation, combined with the ability to make space for reflection in action and to share information with others, showed a significant positive association with interaction. This finding contributes to the literature by showing that a relationship between people who share information when they work together, promotes the creation of a common situation understanding, which in turn provides a basis for decisions that reflects the situation (Watkins and Marsick, 1993; Engeström et al., 1999; Wenger et al., 2002; Comfort, 2007). Researchers have, however, highlighted the problems associated with the low transfer value of learning from specific situations, limitations of understanding (Anderson et al., 1996), and the challenge of creating space for reflection in action (Schön, 1992; Yanow and Tsoukas, 2009). Concurrent learning has, however, demonstrated a promising ability of knowledge creation to reduce the gap between theories, planning, emergency preparedness and practice when unforeseen events occur (Comfort, 2007; Garvin et al., 2008; Simonin, 2017; Torgersen and Steiro, 2018; Visser et al., 2018). Participants must, however, trust each other if this is to take place. They also must develop a mutual understanding which develops during the interaction process and must understand each other's' roles and functions so that they use their unique expertise to complement each other. Finally, they must, if they are to learn from each other in the interaction process, express themselves clearly (Steiro and Torgersen, 2018).

The findings also demonstrated that there was a positive relationship between interaction under risk and those who consider their organization to be trained in decision-making and to have the ability to adapt its organization structure, to be spontaneous and inventive under unforeseen events (Örtenblad, 2004; Cunha et al., 2014; Hadida et al., 2015; Torgersen, 2018b). It is, however, important to measure the risk of *ad-hoc* responses. Sometimes caution and self-protection are chosen and preferred (Cunha et al., 2014). The ability of planning, flexibility and improvisation to coexist must also not be neglected (Giustiniano et al., 2016). The classical emergency preparedness elements of general preparedness, knowledge of existing emergency plans, and the organization's basic capabilities, including material, equipment, and infrastructure, also contributed to the explained interaction variance. This finding, from the domain of operational structure, complements previous results and aligns well with the literature (Steigenberger, 2016; Haddow et al., 2017).

The results of the current study in general propose that educational structure components, in particular concurrent learning, can enhance how people and organizations learn and how they interact in a dynamic process of recovering and improving performance from indeterminate situations. Organizations also need to balance the traditional measures of preparedness, prediction and stability with organizational flexibility and improvisation (Czarniawska, 2009; Christensen et al., 2015).

Second, the results also showed that each competence level had different conditions and starting-points for learning, and that competence could develop from one stage to another (Driscoll, 2000; Benner, 2004). The findings highlight competence level as a tool in managing two dimensions of complexity in interaction under risk, specifically information load and uncertainty (Cannon et al., 2010, p. 172). This finding, though, challenges a traditional view of the unforeseen— "… that there is always something unplanned and unexpected happening, and it is impossible and worthless to build competence and prepare for every possibility" (Torgersen, 2018a, p. 33). Building and developing competence may, however, and to some extent, be sufficient to handle interaction under risk and unforeseen events.

The differences in mean scores between the groups were considered to be small and furthermore did not increase in a stepwise and linear way between competence levels. This finding is not entirely in line with notions of the Dreyfus and Dreyfus' model, which describes a progression through the stages, intuition being the endpoint of learning (Peña, 2010) and expert and master being "… exemplars of exceptional ability" (Yanow and Tsoukas, 2009, p. 1360). Dreyfus and Dreyfus (2005) argue, however, that the master level is always in a learning process, open to change, surprise and not-knowing (Benner, 2004; Yanow and Tsoukas, 2009). This finding, even so, supports previous critics of the model, suggesting that complex processes are oversimplified and that there is an absence of social structure, knowledge, of specifications of objective qualifications, and of operational definitions (Drejer, 2000; Peña, 2010, p. 1–2).

It is possible, though, to partially explain the opposing results of using such models for acquisition of competence for interaction under risk and the unforeseen. For instance, unforeseen events do not have the same degree of predictability, nor seem to evolve in the same way as other and better-known scenarios. Another plausible explanation is that the respondents are individually selected and professionally trained independently of their position, role, and previous education level and that their level of initial competence is therefore high. It is also of interest to consider whether the minor difference between the novice and master levels' response to the unforeseen

is a result of compensation over time. The novice could have an initial or an equal advantage. The master might, however and after a short period of time, reap the benefits of their competence and professional experience. Or could it be the opposite way around? Many studies emphasize the role of masters and experts. Novices must, however, also employ considerable effort in dealing with disruptive situations (Endsley, 1995). This also highlights the differences between formal (explicit) and informal (tacit) knowledge and how it applies, and to what extent, at each competence level (Nonaka, 1994; Drejer, 2000).

Third, the results finally showed that the likelihood of a respondent being a member of a specific competence level group allows different areas of education and training to be emphasized. At the lower competence level in the organization, it appears that interaction, understanding of the unforeseen, concurrent learning—construction, social support from colleagues, and training on decision-making are important factors. At the medium level, however, flexibility and improvisation are central components, which are probably particularly relevant to middle managers. Social support from leader and concurrent learning—reflection are significant at the higher competence level. The support of a leader and the ability to learn as you progress through reflection appear to be increasingly important the higher up in the organization the individual is positioned. These findings support models which claim that it is reasonable to differentiate competence building from competence level and the need to mobilize expertise (Dreyfus and Dreyfus, 1980, 2005; Drejer, 2000; Driscoll, 2000; Weick and Sutcliffe, 2015). An evaluation of which components are considered to be relevant at the different levels appears to reflect a "… move from rule-governed thinking to an intuitive grasp of the situation" (Benner, 2004, p. 190).

According to Peña (2010, p. 8) intuition must be "… expanded to be validated". Research shows that those at a high professional competence level use two modes of thinking: analytic (hypotheticodeductive) and non-analytic (pattern recognition). We must therefore acknowledge the complexity of competence development, decision-making and learning (Peña, 2010), particularly when conditions require new approaches (Garvin et al., 2008). There is furthermore a relationship between these three elements and the different concepts of higher and more advanced levels of learning (Bateson, 1972; Argyris and Schön, 1978, 1996; March, 1991), situational awareness (Endsley, 1995), and organizational sense-making (Weick et al., 2005). For example, improvisation is viewed as being a mechanism that operates between flexibility and structure, and exploration and exploitation, and is viewed as being a skill that can be learned through training (Vera and Crossan, 2005, p. 220). Improvising can, according to Weick (1998, p. 553), also be tacit and often distracted by structure, planning and standard operating procedures. The relationship between cognition, intuition and action may therefore transform emergency management from being a static, rule-bound set of procedures into a dynamic process, based on the human and the organizational interactive ability to learn, share knowledge, improvise, and adapt to changing conditions across competence levels (Comfort, 2007, p. 189; Noe et al., 2014; Yeo and Marquardt, 2015). Consideration should therefore be given to whether models other than linear models of competence development and knowledge creation are more suitable to interaction under risk.

An example of an alternative model is the SECI (Socialization-Externalization-Combination-Internalization) model of knowledge creation in organizations (Nonaka and Konno, 1998; Nonaka et al., 2000). It seems to be increasingly important that higher levels of learning (Wang and Ahmed, 2003) are achieved through a dialectic process (or spiral) (Nonaka and Toyama, 2003) if knowledge is to be transferred between the individual, group, intra-organizational, and inter-organizational levels. This is furthermore a process which enables conversion between tacit and explicit knowledge (Nonaka, 1994). This model sheds light on the complex process of competence development. Such models could also be useful in the creation and generation of a new and deeper understanding and knowledge in situations that require interaction to cope with ambiguity, chaos, fluctuation, and uncertainty. They do, however, focus on competence or knowledge in an overall perspective. Less interventional measures are, however, required to develop concrete interaction abilities that can meet unforeseen events (Torgersen et al., 2018, p. 34). Organizations should, nevertheless and based on the results, implement a broader perspective of learning and competence development and recognize that interaction is a generic core competence. This is built on social support and concurrent learning, but also includes the skills of improvisation and flexibility. The findings of our study have therefore identified and concretized specific areas of competence which can form the basis for progress in recruitment and selection procedures, educational programs, operational training and emergency exercises, at both the individual, group and organizational level.

Strengths and Limitations

The cross-sectional design prohibits causal inferences, implying that our study can only provide conclusions on the associations between the examined variables (Gollob and Reichardt, 1987). A theoretical model of interaction under risk and certain components associated with interaction have formed the basis of this study. The selection, division, and sequence of factors must not be perceived as absolute, causal or categorical. Determinants in the study might also influence each other bidirectionally. Longitudinal studies or interventional study designs are therefore needed to infer temporal relationships between the study variables and to adjust for potential confounders. The sample size ($n = 917$), however, should be sufficient to detect large effects (Cohen, 1988). Additionally, the variables were measured by a multi-item scale with high reliability and the response rate (87%) was also high (Lindell and Whitney, 2001).

Self-reported data were also used in this study. The data are based on employees' perceptions of their organization's ability to interact under risk and to handle unforeseen events. Thus, the study does not look at the participants' actual behavior during an event, but at the intended behavior based on their experience. This may limit the validity of our findings due to common method bias and social desirability (Podsakoff et al., 2003). The assessment of social support and the basic educational, organizational and operational components of interaction under

risk could therefore reflect general and biased intentions, rather than real organizational performance when confronted with an unforeseen event. The respondents are selected, trained and relatively experienced and this should contribute to a realistic evaluation of the organization. The questionnaire was, to lessen such limitations, completed in plenum. All participants were given the same introduction. We undertook further procedural remedies such as ensuring anonymity of the respondents. The respondents were also informed that the data would only be used for research purposes and was solely available to the authors of this study.

The selection of participants, who were all volunteers, may also introduce uncertainty to the results and limit generalizability to other populations (Lindell and Whitney, 2001). Randomization was not possible in order to obtain a representative sample of knowledge and experience from risk and unforeseen events. The respondents do, however, represent a large and diverse sample of Norwegian Armed Forces personnel. The participants are selected from a range of units, functions and roles with respect to attributes and representation of the population, which should reduce the possibility of bias and localization or group specific effects.

The incidence of missing data were low, and the response rate was high. The sample in this study is from the Norwegian Armed Forces. The phenomenon and thematic approach used in this study is, however, industry-oriented, sector-oriented and cross-sectoral. However, the results should not be generalized to employees in other sectors.

CONCLUSION

In conclusion, the results of this current study show that it is possible to prepare for unforeseen events by implementing measures that promote better interaction, particularly measures aimed at the improvement of social support and concurrent learning. The categorization of the factors into educational, organizational and operational structures also gave increased insight into the basic components of interaction under risk. This insight furthermore established a foundation that could be used in the development of a methodology and education models that are relevant for different levels of competence. The importance of a multivariate and interdisciplinary approach to the identification of factors that affect the ability to interact under risk and unforeseen events was accentuated. More importantly, several factors that could provide better targeting and emergent applicable generic competence structures for interaction under risk were identified. This is useful in developing and adjusting recruitment and selection processes, educational models, training programs, emergency exercises, and organization.

Transboundary threats and events at the outer limits of what has been prepared for and trained for previously must also be handled, not least, to ensure societal security and preparedness. This study therefore provides an explanation of the unforeseen in society and learning processes, by introducing the concept of interaction under risk, a term that connotes coexisting, communication, cooperation, coordination and collaboration in one word.

If, as pointed out by the literature, unforeseen events are both inevitable and unpredictable, learning how to deal with them as they unfold seems to be adequate. Traditional efforts to predict and control, to defend against specific hazards and risks, should therefore be combined with an increased attention on interaction abilities, social support, concurrent learning, improvisation and flexibility. Experiences from unforeseen events, however, point to the multi-faceted nature of this phenomenon. Developing principles and general solutions that apply to all situations is highly unlikely. This study, nevertheless, suggests that people and organizations who learn and interact in a social, dynamic and synthesizing process will be one step ahead in recovering and improving performance from indeterminate situations. The current study should therefore be particularly relevant to organizations involved in the handling and stabilization of unforeseen events, emergency preparedness and crisis management.

Future research should pursue the findings empirically in longitudinal designs, to clarify and observe more closely the interactive relationship between the study variables. The educational, organizational and operational structures of interaction under risk in particular need to be more closely examined, including in relation to different organizations and cultures, both national and international. Research into the individual differences in handling unforeseen events and interaction under risk that relates to mental abilities, personality, motivation, and character, could contribute to the better understanding of the influence of individual and social factors. Learning is a key feature in this study, which is mainly viewed as being a positive process. Constraints on learning and interaction must also be further explored. So should unlearning processes.

ETHICS STATEMENT

This study was carried out in accordance with the ethical code of the Norwegian University of Science and Technology and using the guidelines for research ethics of the Norwegian National Committees for Research Ethics. Participation in the study was voluntary. All subjects gave written informed consent in accordance with the Declaration of Helsinki. The participants could withdraw their consent at any time without giving a reason. The personal data were processed confidentially and in accordance with the data protection legislation.

This study did not involve direct contact with the participants by intervention and invasive studies, the collection of human biological material, or by obtaining personal health information. It did not need Ethical approval from The Regional Committees for Medical and Health Research Ethics (REC). However, the project has been notified to The Data Protection Official for Research at NSD—Norwegian Center for Research Data AS (personvernombudet@nsd.no, +47 55 58 21 17), with the following reference number: ID 50898).

AUTHOR CONTRIBUTIONS

MH and G-ET conducted the data collection. All authors decided on the research questions, conducted the analysis, and revising the manuscript. MH wrote the paper. All the authors discussed and commented on the final version of the manuscript and agreed to be accountable for all aspects of the work and have read and approved final version for publication and designed and adopted the study.

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REFERENCES

Alpaslan, C. M., and Mitroff, I. I. (2011). *Swans, Swine, and Swindlers: Coping with the Growing Threat of Mega-Crises and Mega-Messes*. Stanford, CA: Stanford University Press.

Anderson, J. R., Reder, L. M., and Simon, H. A. (1996). Situated learning and education. *Educ. Res.* 25, 5–11. doi: 10.3102/0013189X025004005

Anderson, L. W., and Krathwohl, D. R. (eds.). (2001). *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives*. New York, NY: Addison Wesley Longman.

Ansell, C., Boin, A., and Keller, A. (2010). Managing transboundary crises: identifying the building blocks of an effective response system. *J. Contingencies Crisis Manag.* 18, 195–207. doi: 10.1111/j.1468-5973.2010.00620.x

Antonacopoulou, E., and Chiva, R. (2007). The social complexity of organizational learning: the dynamics of learning and organizing. *Manag. Learn.* 38, 277–295. doi: 10.1177/1350507607079029

Antonacopoulou, E. P. (1999). Training does not imply learning: the individuals' perspective. *Int. J. Train. Dev.* 3, 14–33. doi: 10.1111/1468-2419.00061

Antonacopoulou, E. P. (2001). The paradoxical nature of the relationship between training and learning. *J. Manag. Stud.* 38, 327–350. doi: 10.1111/1467-6486.00239

Antonacopoulou, E. P., and Sheaffer, Z. (2014). Learning in crisis: rethinking the relationship between organizational learning and crisis management. *J. Manag. Inq.* 23, 5–21. doi: 10.1177/1056492612472730

Argyris, C., and Schön, D. (1978). *Organizational Learning: A Theory of Action Perspective*. Reading, MA: Addison-Wesley Publishing Company.

Argyris, C., and Schön, D. (1996). *Organizational Learning II: Theory, Method and Practice.* Reading, MA: Addison-Wesley Publishing Company.

Armistead-Jehle, P., Johnston, S. L., Wade, N. G., and Ecklund, C. J. (2011). Posttraumatic stress in US Marines: the role of unit cohesion and combat exposure. *J. Counsel. Dev.* 89, 81–88. doi: 10.1002/j.1556-6678.2011.tb00063.x

Bammer, G., and Smithson, M. (eds.). (2009). *Uncertainty and Risk: Multidisciplinary Perspectives*. New York, NY: Routledge.

Barnett, R. (2004). Learning for an unknown future. *High. Educ. Res. Dev.* 23, 247–260. doi: 10.1080/0729436042000235382

Bartlett, M. S. (1954). A note on the multiplying factors for various chi-square approximations. *J. R. Stat. Soc.* 16, 296–298. doi: 10.1111/j.2517-6161.1954.tb00174.x

Bateson, G. (1972). *Steps to an Ecology of Mind*. San Francisco, CA: Chandler.

Bechky, B. A., and Okhuysen, G. A. (2011). Expecting the unexpected? Swat officers and film crews handle surprises. *Acad.Manag. J.* 54, 239–261. doi: 10.5465/amj.2011.60263060

Benner, P. (2004). Using the Dreyfus model of skill acquisition to describe and interpret skill acquisition and clinical judgment in nursing practice and education. *Bull.Sci. Technol. Soc.* 24, 188–199. doi: 10.1177/0270467604265061

Berlin, J. M., and Carlström, E. D. (2011). Why is collaboration minimized at the accident scene? *Disaster Prev. Manag.* 20, 159–171. doi: 10.1108/09653561111126094

Berlin, J. M., and Carlström, E. D. (2015). Collaboration exercises: what do they contribute? *J. Contingencies Crisis Manag.* 23, 11–23. doi: 10.1111/1468-5973.12064

Bliese, P. D., and Britt, T. W. (2001). Social support, group consensus and stressor- strain relationship: social context matters. *J. Org. Behav.* 22, 425–436. doi: 10.1002/job.95

Bloom, B. S. (ed.). (1956). *Taxonomy of Educational Objectives: Handbook I: Cognitive Domain*. New York, NY: David McKay Co., Inc.

Boin, A., Hart, P., Stern, E., and Sundelius, B. (2005). *The Politics of Crisis Management. Public Leadership Under Pressure*. Cambridge: Cambridge University Press.

Boin, A., and Lagadec, P. (2000). Preparing for the future: critical challenges in crisis management. *J. Contingencies Crisis Manag.* 8, 185–191. doi: 10.1111/1468-5973.00138

Boin, A., and McConnell, A. (2007). Preparing for critical infrastructure breakdowns: the limits of crisis management and the need for resilience. *J. Contingencies Crisis Manag.* 15, 50–59. doi: 10.1111/j.1468-5973.2007.00504.x

Boin, A., and van Eeten, M. J. G. (2013). The resilient organization. *Public Manag. Rev.* 15, 429–445. doi: 10.1080/14719037.2013.769856

Bonanno, G. A., Brewin, C. R., Kaniasty, K., and La Greca, A. M. (2010). Weighing the costs of disaster: consequences, risks, and resilience in individuals, families, and communities. *Psychol. Sci. Public Interest*, 11, 1–49. doi: 10.1177/1529100610387086

Boston, J., and Gill, D. (2011). *Joint or Shared Accountability: Issues and Options.* Wellington: Institute of Policy Studies

Bundy, J., Pfarrer, M. D., Short, C. E., and Coombs, W. T. (2017). Crises and crisis management: integration, interpretation, and research development. *J. Manag.* 43, 1661–1692. doi: 10.1177/0149206316680030

Cannon, H. M., Feinstein, A. H., and Friesen, D. P. (2010). Managing complexity: applying the conscious-competence model to experiential learning. *Dev. Bus. Simul. Exp. Learn.* 37, 172–182. Available online at: http://absel.org

Cattell, R. B. (1966). The Scree test for the number of factors. *Multivariate Behav. Res.* 1, 245–276. doi: 10.1207/s15327906mbr0102_10

Christensen, T., Lægreid, P., and Rykkja, L. (2015). The challenges of coordination in national security management – the case of the terrorist attack in Norway. *Int. Rev. Adm. Sci.* 81, 352–372. doi: 10.1177/0020852314564307

Christensen, T., Lægreid, P., and Rykkja, L. (2016). Organizing for crisis management: building governance capacity and legitimacy. *Public Adm. Rev.* 76, 887–897. doi: 10.1111/puar.12558

Christianson, M. K., Farkas, M. T., Sutcliffe, K. M., and Weick, K. E. (2009). Learning through rare events: significant interruptions at the Baltimore and Ohio railroad museum. *Org. Sci.* 20, 846–860. doi: 10.1287/orsc.1080.0389

Cobb, J. (1976). Social support as a moderator of life stress. *Psychosom. Med.* 38, 300–314. doi: 10.1097/00006842-197609000-00003

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences*. New York, NY: Routledge Academic.

Cohen, S. (2004). Social relationships and health. *Am. Psychol.* 59, 676–684. doi: 10.1037/0003-066X.59.8.676

Comfort, L. K. (2007). Crisis management in hindsight: cognition, communication, coordination, and control. *Public Adm. Rev.* 67, 189–197. doi: 10.1111/j.1540-6210.2007.00827.x

Cortina, J. M. (1993). What is coefficient alpha? An examination of theory and applications. *J. Appl. Psychol.* 78, 98–104. doi: 10.1037/0021-9010.78.1.98

Costello, A. B., and Osborne, J. W. (2005). Best practices in exploratory factor analysis: four recommendations for getting the most from your analysis. *Pract. Assess. Res. Eval.* 10, 1–9. Available online at: http://pareonline.net/pdf/v10n7.pdf

Cunha, M. P., Clegg, S. R., Rego, A., and Neves, P. (2014). Organizational improvisation: from the constraint of strict tempo to the power of the avant-garde. *Creat. Innov. Manag.* 23, 359–373. doi: 10.1111/caim.12076

Cunha, M. P., Cunha, J. V., and Kamoche, K. (1999). Organizational improvisation: what, when, how, and why. *Int. J. Manag. Rev.* 1, 299–341. doi: 10.1111/1468-2370.00017

Czarniawska, B. (ed.). (2009). *Organizing in the Face of Risk and Threat*. Northampton, MA: Edward Elgar.

Delahaij, R., Kamphuis, W., and van den Berg, C. E. (2016). Keeping engaged during deployment: the interplay between self-efficacy, family support, and threat exposure. *Mil. Psychol.* 28, 78–88. doi: 10.1037/mil0000098

Drejer, A. (2000). Organizational learning and competence development. *Learn. Org.* 7, 206–220. doi: 10.1108/09696470010342306

Dreyfus, H. L., and Dreyfus, S. E. (2005). Peripheral vision: expertise in real world contexts. *Org. Stud.* 26, 779–792. doi: 10.1177/0170840605053102

Dreyfus, S. E. (1981). *Formal Models vs. Human Situational Understanding: Inherent Limitations on the Modeling of Business Expertise*. Berkeley, CA: University of California.

Dreyfus, S. E., and Dreyfus, H. L. (1980). *A Five-Stage Model of the Mental Activities Involved in Directed Skill Acquisition.* Berkeley, CA: University of California.

Driscoll, M. (2000). *Psychology of Learning for Instruction, 3rd Edn*. Needham Heights, MA: Allyn and Bacon.

Duijm, N. J. (2015). Review: recommendations on the use and design of risk matrices. *Saf. Sci.* 76, 21–31. doi: 10.1016/j.ssci.2015.02.014

Endsley, M. R. (1995). Toward a theory of situation awareness in dynamic systems. *Hum. Factor.* 37, 32–64. doi: 10.1518/001872095779049543

Engeström, Y., Miettinen, R., and Punamäki, R. L. E. (eds.). (1999). *Perspectives on Activity Theory. Learning in Doing: Social, Cognitive and Computational Perspectives*. Cambridge: Cambridge University Press.

Flage, R., and Aven, T. (2015). Emerging risk – conceptual definition and a relation to black swan type of events. *Reliability Eng. Syst. Saf.* 144, 61–67. doi: 10.1016/j.ress.2015.07.008

Gagné, R. M. (1972). Domains of learning. *Interchange* 3, 1–8. doi: 10.1007/BF02145939

Garvin, D. A., Edmondson, A. C., and Gino, F. (2008). Is yours a learning organization? *Harv. Bus. Rev.* 86, 109–116.

Giustiniano, L., Cunha, M., and Stewart, C. (2016). The dark side of organizational improvisation: lessons from the sinking of Costa Concordia. *Bus. Horiz.* 59, 223–232. doi: 10.1016/j.bushor.2015.11.007

Glozah, F. N., and Pevalin, D. J. (2017). Psychometric properties of the Perceived Social Support from Family and Friends Scale: data from an adolescent sample in Ghana. *J. Child Fam. Stud.* 26, 88–100. doi: 10.1007/s10826-016-0535-1

Gollob, H. F., and Reichardt, C. S. (1987). Taking account of time lags in causal models. *Child Dev.* 58, 80–92. doi: 10.2307/1130293

Griffith, J., and Vaitkus, M. (1999). Relating cohesion to stress, strain, disintegration, and performance: an organizing framework. *Mil. Psychol.* 11, 27–55. doi: 10.1207/s15327876mp1101_3

Haddow, G., Bullock, J., and Coppola, D. (2017). *Introduction to Emergency Management, 6th Edn*. Oxford: Elsevier Inc, Butterworth-Heinemann.

Hadida, A. L., Tarvainen, W., and Rose, J. (2015). Organizational improvisation: a consolidating review and framework. *Int. J. Manag. Rev.* 17, 437–459. doi: 10.1111/ijmr.12047

Hao, J., Liu, L., von Davier, A. A., and Kyllonen, P. C. (2017). "Initial steps towards a standardized assessment for collaborative problem solving (CPS): practical challenges and strategies," in *Innovative Assessment of Collaboration. Methodology of Educational Measurement and Assessment*, eds A. von Davier, M. Zhu, P. Kyllonen (Cham: Springer), 135–156.

Harrow, A. (1972). *A Taxonomy of Psychomotor Domain: A Guide for Developing Behavioral Objectives*. New York, NY: David McKay Co., Inc.

Hawkins, P. (1991). The spiritual dimension of the learning organization. *Manag. Educ. Dev.* 22, 172–187. doi: 10.1177/135050769102200304

Head, B. W., and Alford, J. (2015). Wicked problems: implications for public policy and management. *Adm. Soc.* 47, 711–739. doi: 10.1177/0095399713481601

Hémond, Y., and Robert, B. (2012). Preparedness: the state of the art and future prospects. *Disaster Prev. Manag. Int. J.* 21, 404–417. doi: 10.1108/09653561211256125

Herberg, M., Torgersen, G.-E., and Rundmo, T. (2018). "Competence for the unforeseen – the importance of human, social and organizational factors," in *Interaction: 'Samhandling' Under Risk. A Step Ahead of the Unforeseen,* ed G.-E. Torgersen (Oslo: Cappelen Damm Akademisk), 267–300.

Hosmer, D. W., Lemeshow, S., and Sturdivant, R. X. (2013). *Applied Logistic Regression, 3rd Edn*. New York, NY: John Wiley and Sons.

Huber, G. (1991). Organizational learning: the contributing processes and the literatures. *Org. Sci.* 2, 88–115.

Jain, A. K. (2010). Data clustering: 50 years beyond K-means. *Pattern Recognit. Lett.* 31, 651–666. doi: 10.1016/j.patrec.2009.09.011

Jung, K., and Song, M. (2015). Linking emergency management networks to disaster resilience: Bonding and bridging strategy in hierarchical or horizontal collaboration networks. *Qual. Quan. Int. J. Methodol.* 1465–1483. doi: 10.1007/s11135-014-0092-x

Kaarstad, M., and Torgersen, G.-E. (2017). Is it possible to assess an organization's preparedness for the unforeseen? Development and evaluation of a methodology. *Arts Soc. Sci. J.* 8, 1–7. doi: 10.4172/2151-6200.1000254

Kaiser, H. F. (1974). An index of factorial simplicity. *Psychometrika* 39, 31–36. doi: 10.1007/BF02291575

Kettl, D. F. (2003). Contingent coordination: practical and theoretical puzzles for homeland security. *Am. Rev. Public Adm.* 33, 253–277. doi: 10.1177/0275074003254472

Kolb, D. A. (1984). *Experiential Learning: Experience as the Source of Learning and Development*. Englewood Cliffs, NJ: Prentice-Hall.

Krathwohl, D. R. (2002). A revision of Bloom's taxonomy: an overview. *Theory Pract.* 41, 212–218. doi: 10.1207/s15430421tip4104_2

Krathwohl, D. R., Bloom, B. S., and Masia, B. B. (1964). *Taxonomy of Educational Objectives, the Classification of Educational Goals. Handbook II: Affective Domain*. New York, NY: David McKay Co., Inc.

Lakens, D. (2013). Calculating and reporting effect sizes to facilitate cumulative science: a practical primer for *t*-tests and ANOVAs. *Front. Psychol.* 4, 1–10. doi: 10.3389/fpsyg.2013.00863

Lave, J., and Wenger, E. (1991). *Situated Learning: Legitimate Peripheral Participation*. Cambridge: Cambridge University Press. doi: 10.1017/CBO9780511815355

Lindell, M. K., and Whitney, D. J. (2001). Accounting for common method variance in cross-sectional research designs. *J. Appl. Psychol.* 86, 114–121. doi: 10.1037/0021-9010.86.1.114

Lu, X., and Xue, L. (2016). Managing the unexpected: sense-making in the Chinese emergency management system. *Public Adm.* 94, 414–429. doi: 10.1111/padm.12261

March, J. (1991). Exploration and exploitation in organizational learning. *Org. Sci.* 2, 71–87.

Marquardt, M. J. (2011). *Building the learning organization, Achieving Strategic Advantage through a Commitment to Learning, 3rd Edn*. Boston, MA: Nicholas Brealey Publishing.

Marsick, V. J., and Watkins, K. E. (2003). Demonstrating the value of an organization's learning culture: the dimensions of the learning organization questionnaire. *Adv. Dev. Hum. Resour.* 5, 132–151. doi: 10.1177/1523422303005002002

Martin, E., Nolte, I., and Vitolo, E. (2016). The four Cs of disaster partnering: communication, cooperation, coordination and collaboration. *Disasters* 40, 621–643. doi: 10.1111/disa.12173

Noe, R. A., Clark, A. D. M., and Klein, H. J. (2014). Learning in the twenty-first-century workplace. *Annu. Rev. Org. Psychol. Org. Behav.* 1, 245–275. doi: 10.1146/annurev-orgpsych-031413-091321

Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Org. Sci.* 5, 14–37. doi: 10.1287/orsc.5.1.14

Nonaka, I., and Konno, N. (1998). The concept of "ba": building a foundation for knowledge creation. *Calif. Manag. Rev.* 40, 40–54. doi: 10.2307/41165942

Nonaka, I., and Toyama, R. (2003). The knowledge-creating theory revisited: knowledge creation as a synthesizing process. *Knowl. Manag. Res. Pract.* 1, 2–10. doi: 10.1057/palgrave.kmrp.8500001

Nonaka, I., Toyama, R., and Konno, N. (2000). SECI, Ba and leadership: a unified model of dynamic knowledge creation. *Long Range Plann.* 33, 5–34. doi: 10.1016/S0024-6301(99)00115-6

O'Leary, R., and Vij, N. (2012). Collaborative public management: where have we been and where are we going? *Am. Rev. Public Adm.* 42, 507–522. doi: 10.1177/0275074012445780

Örtenblad, A. (2002). A typology of the idea of learning organization. *Manag. Learn.* 33, 213–230. doi: 10.1177/1350507602332004

Örtenblad, A. (2004). The learning organization: towards an integrated model. *Learn. Org.* 11, 129–144. doi: 10.1108/09696470410521592

Örtenblad, A. (2018). What does "learning organization" mean? *Learn. Org.* 25, 150–158. doi: 10.1108/TLO-02-2018-0016

Osborne, J. W. (2015). What is rotating in exploratory factor analysis? *Pract. Assess. Res. Eval.* 20, 1–7. Available online at: http://pareonline.net/getvn.asp?v=20&n=2

Pearson, C. M., and Mitroff, I. I. (1993). From crisis prone to crisis prepared: a framework for crisis management. *Executive* 7, 48–59. doi: 10.5465/ame.1993.9409142058

Peña, P. (2010). The Dreyfus model of clinical problem-solving skills acquisition: a critical perspective. *Med. Educ. Online* 15, 1–11. doi: 10.3402/meo.v15i0.4846

Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., and Podsakoff, N. P. (2003). Common method biases in behavioral research: a critical review of the literature and recommended remedies. *J. Appl. Psychol.* 88, 879–903. doi: 10.1037/0021-9010.88.5.879

Procidano, M. E., and Heller, K. (1983). Measures of perceived social support from friends and from family: three validation studies. *Am. J. Commun. Psychol.* 11, 1–24. doi: 10.1007/BF00898416

Rundmo, T. (2018). "Is it possible to prevent unforeseen events?," in *Interaction: 'Samhandling' Under Risk. A Step Ahead of the Unforeseen,* ed G.-E. Torgersen (Oslo: Cappelen Damm Akademisk), 55–74.

Ryan, D. M., and Burrell, L. (2012). "What they deserve. Quality of life in U.S. military," in *The Oxford Handbook of Military Psychology,* eds J. H. Laurence, and M. D. Matthews (New York, NY: Oxford University Press), 381–399.

Saeverot, H. (2017). *Pedagogikkvitenskap [Pedagogical Science]*. Bergen: Fagbokforlaget.

Sawalha, I. H. S. (2014). Collaboration in crisis and emergency management: identifying the gaps in the case of storm "Alexa". *J. Bus. Continuity Emerg. Plann.* 7:312–323.

Schecter, A., and Contractor, N. (2017). "Understanding and assessing collaborative processes through relational events," in *Innovative Assessment of Collaboration. Methodology of Educational Measurement and Assessment*, eds A. von Davier, M. Zhu, P. Kyllonen (Cham: Springer), 223–231. doi: 10.1007/978-3-319-33261-1_14

Schön, D. A. (1992). The theory of inquiry: Dewey's legacy to education. *Curriculum Inq.* 22, 119–139. doi: 10.1080/03626784.1992.11076093

Scott, A. J., and Knott, M. (1974). A cluster analysis method for grouping means in the analysis of variance. *Biometrics* 30, 507–512. doi: 10.2307/2529204

Selden, S., Sowa, J., and Sandfort, J. (2006). The impact of nonprofit collaboration in early child care and education on management and program outcomes. *Public Adm. Rev.* 66, 412–425. doi: 10.1111/j.1540-6210.2006.00598.x

Selznick, P. (1957). *Leadership in Administration*. New York, NY: Harper and Row.

Simonin, B. L. (2017). N-loop learning: part I – of hedgehog, fox, dodo bird and sphinx. *Learn. Org.* 24, 169–179. doi: 10.1108/TLO-12-2016-0099

Sorensen, J. L., Carlström, E. D, Magnussen, L. I., Kim, T., Christiansen, A. M., and Torgersen, G-E. (2018). Old dogs, new tricks? A Norwegian study on whether previous collaboration exercise experience impacted participant's perceived exercise effect. *Int. J. Emerg. Serv*. doi: 10.1108/IJES-04-2018-0025. [Epub ahead of print].

Steigenberger, N. (2016). Organizing for the big one: a review of case studies and a research agenda for multi-agency disaster response. *J. Contingencies Crisis Manag.* 24, 60–72. doi: 10.1111/1468-5973.12106

Steiro, T. J., and Torgersen, G.-E. (2018). "Samhandling under risk: applying concurrent learning to prepare for and meet the unforeseen," in *Interaction: "Samhandling" Under Risk. A Step Ahead of the Unforeseen*, ed G.-E. Torgersen (Oslo: Cappelen Damm Akademisk), 251–266.

Stufflebeam, D. L. (2001). Evaluation checklists: practical tools for guiding and judging evaluations. *Am. J. Eval.* 22, 71–79. doi: 10.1177/109821400102200107

Stufflebeam, D. L., and Shinkfield, A. J. (2007). *Evaluation Theory, Models, and Applications*. San Francisco, CA: Jossey-Bass.

Tabachnick, B. G., and Fidell, L. S. (2013). *Using Multivariate Statistics, 6th Edn*. Boston, MA: Pearson.

Taleb, N. N. (2010). *The Black Swan: The Impact of the Highly Improbable, 2nd Edn*. New York, NY: Random House Trade Paperbacks.

Torgersen, G.-E. (2018a). "Samhandling under risk (SUR) – theoretical foundation as a common frame of reference," in *Interaction: "Samhandling" Under Risk. A Step Ahead of the Unforeseen*, e. G.-E. Torgersen (Oslo: Cappelen Damm Akademisk), 19–38.

Torgersen, G.-E. (ed.). (2018b). *Interaction: "Samhandling" Under Risk. A Step Ahead of the Unforeseen*. Oslo: Cappelen Damm Akademisk.

Torgersen, G.-E., Saeverot, H., Steiro, T. J., and Kawano, H. (2018). "Basic structures for a new theory of samhandling under risk (SUR) – a model," in *Interaction: "Samhandling" Under Risk. A Step Ahead of the Unforeseen*, ed G.-E. Torgersen (Oslo: Cappelen Damm Akademisk), 519–540.

Torgersen, G.-E., and Steiro, T. J. (2009). *Ledelse, Samhandling og Opplæring Ifleksible Organisasjoner [Leadership, Interaction and Education in Flexible Organizations]*. Stjørdal: Læringsforlaget.

Torgersen, G.-E., and Steiro, T. J. (2018). "Defining the term samhandling," in *Interaction: "Samhandling" Under Risk. A Step Ahead of the Unforeseen*, ed G.-E. Torgersen (Oslo: Cappelen Damm Akademisk, 39–54.

Van Wart, M., and Kapucu, N. (2011). Crisis management competencies. *Public Manag. Rev.* 13, 489–511. doi: 10.1080/14719037.2010.525034

Vera, D., and Crossan, M. (2005). Improvisation and innovative performance in teams. *Org. Sci.* 16, 203–224. doi: 10.1287/orsc.1050.0126

Visser, M., Chiva, R., and Tosey, P. (2018). Guest editorial. *Learn. Org.* 25, 218–223. doi: 10.1108/TLO-02-2018-0021

von Davier, A. A., Zhu, M., and Kyllonen, P. C. (2017). *Innovative Assessment of Collaboration: Methodology of Educational Measurement and Assessment*. Cham: Springer.

Wang, C. L., and Ahmed, P. K. (2003). Organizational learning: a critical review. *Learn. Org.* 10, 8–17. doi: 10.1108/09696470310457469

Watkins, K. E., and Marsick, V. J. (1993). *Sculpting the Learning Organization: Lessons in the Art and Science of Systemic Change*. San Francisco, CA: Jossey-Bass.

Watkins, M. W. (2000). *Monte Carlo PCA for Parallel Analysis [Computer Software]*. State College, PA: Ed and Psych Associates.

Weick, K. E. (1998). Introductory essay—improvisation as a mindset for organizational analysis. *Org. Sci.* 9, 543–555. doi: 10.1287/orsc.9.5.543

Weick, K. E., and Sutcliffe, K. M. (2015). *Managing the Unexpected: Sustained Performance in a Complex World, 3rd Edn*. Hoboken, NJ: John Wiley and Sons, Inc.

Weick, K. E., Sutcliffe, K. M., and Obstfeld, D. (2005). Organizing and the process of sensemaking. *Org. Sci.* 16, 409–421. doi: 10.1287/orsc.1050.0133

Wenger, E. C., McDermott, R., and Snyder, W. C. (2002). *Cultivating Communities of Practice: A Guide to Managing Knowledge*. Cambridge: Harvard Business School Press.

Yanow, D., and Tsoukas, H. (2009). What is reflection-in-action? A phenomenological account. *J. Manag. Stud.* 46, 1339–1364. doi: 10.1111/j.1467-6486.2009.00859.x

Yeo, R. K., and Marquardt, M. J. (2015). (Re)interpreting action, learning, and experience: Integrating action learning and experiential learning for HRD. *Hum. Resour. Dev. Q.* 26, 81–107. doi: 10.1002/hrdq.21199

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